CORPORATE FORECASTING

OIL PRICE IMPACTS ON THE EDMONTON ECONOMY: AN ECONOMETRIC ANALYSIS

Research Paper No. 9

THE CITY OF Edmonton PLANNING AND BUILDING

Research Paper No. 9

OIL PRICE IMPACTS ON THE EDMONTON ECONOMY

- An Econometric Analysis -

by

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IMPORTANT NOTE

This Technical Paper has been prepared by the Corporate Forecasting Group, Long Range Planning Branch, Planning and Building Department. The Paper documents research results as part of an ongoing forecasting activity. Neither the methods nor the results have been endorsed by the City of Edmonton.

October, 1986

TABLE OF CONTENTS

Page

List of Tables

List of Charts

Acknowledgments

1. Introduction 1

2. The Theoretical Model 2
   - 2.1 Alberta's General Economic Activity 2
   - 2.2 Edmonton Labour Market 6
   - 2.3 Wages and Prices 11

3. Estimation of the Model 15
   - 3.1 Alberta's General Economic Activity 15
   - 3.2 Edmonton Labour Market 15
   - 3.3 Wages and Prices 16

4. Impacts of Oil Prices 19

5. Conclusions 22

Bibliography 28

Appendix: Historical Data, 1971-1985 29

LIST OF TABLES

Page

1. Oil Price Impacts on the Edmonton Economy
   - City Forecast Committee's Scenario 23

2. Oil Price Impacts on the Edmonton Economy
   - Base Case Scenario 24

LIST OF CHARTS

		Page
1.	Alberta's Real Gross Domestic Product	25
2.	Alberta's Economic Growth Rate	25
3.	Alberta's Real Personal Income Per Capita	25
4.	Edmonton CMA's Population	25
5.	Edmonton CMA's Labour Force Participation Rate	26
6.	Edmonton CMA's Labour Force	26
7.	Edmonton CMA's Total Employment	26
8.	Edmonton CMA's Unemployment Rate	26
9.	Edmonton CMA's Weekly Wage Increase	27
10.	Edmonton CMA's Consumer Price Increase	27
11.	Edmonton CMA's New Housing Price Increase	27
12.	Canada's Industrial Selling Price Increase	27

ACKNOWLEDGEMENTS

I wish to express my thanks to Harvey Crone and other staff in the Corporate Forecasting Group of the Long Range Planning Branch for reviewing earlier drafts of this paper and for offering comments and suggestions.

My thanks are also due to Chris Yap and Tim Ford for their assistance in collecting data and estimating and simulating the model, and to the Word Processing Section of the Planning and Building Department for their excellent typing.

OIL PRICE IMPACTS ON THE EDMONTON ECONOMY
- AN ECONOMETRIC ANALYSIS -

1. INTRODUCTION

In a previous paper (Huang, June 1986), the impacts of different world oil prices on the Alberta economy were investigated by means of a macroeconometric model of the Alberta economy. In this paper, a similar macroeconometric model is developed for the Edmonton economy and the impacts of oil price changes on various indicators of the Edmonton economy such as population, labour force, employment, unemployment rate, wages and prices are discussed. In addition, the model can be used to assess the impacts of the Edmonton economy of government policy changes in interest rates and taxation on the oil and gas industry. Because of the linkage between these two papers, some of the theoretical relationships among different economic factors contained in this paper are borrowed heavily from the previous paper. The macroeconometric model developed for the Edmonton economy is dynamic and simultaneous in nature, reflecting the interrelationships among various economic forces and between different time periods. The model developed in this paper will be integrated with other models into a large scale model entitled An Econometric Model of The Edmonton Economy.

Data used in this paper are for the Edmonton Census Metropolitan Area as defined by Statistics Canada, but this reference will be dropped and only "Edmonton" will be used throughout this paper.

In Section 2, a theoretical model is developed for Edmonton's labour market, wages and prices. The model consists of twelve structural equations describing the functional causal relationships among various economic factors and three definitional equations showing the accounting relationships among some variables.

The structural equations are tested and their parameters are estimated in Section 3, using data for the period 1971 to 1985. In Section 4, the estimated model is simulated to predict future values for all endogenous variables based on two different oil price scenarios and a comparison is made between the two sets of results.

2. THE THEORETICAL MODEL

The model consists of three blocks: (1) Alberta general economic activity as measured by Alberta's gross domestic product, Alberta's employment, Alberta's personal income and Alberta's population; (2) Edmonton's labour market, including variables such as labour force, employed labour force and unemployment rate; (3) Edmonton's wages and prices variables such as consumer prices and new housing prices. Canada's industrial selling price is also included in this model because this variable is expected to affect local consumer prices and a forecast of this variable is also required for departmental budget preparation for material purchases. The flow chart shown in Figure 1 displays the interrelationships among variables between the blocks and within each block. Each of these three blocks is examined in some detail in the following.

2.1 Alberta's General Economic Activity

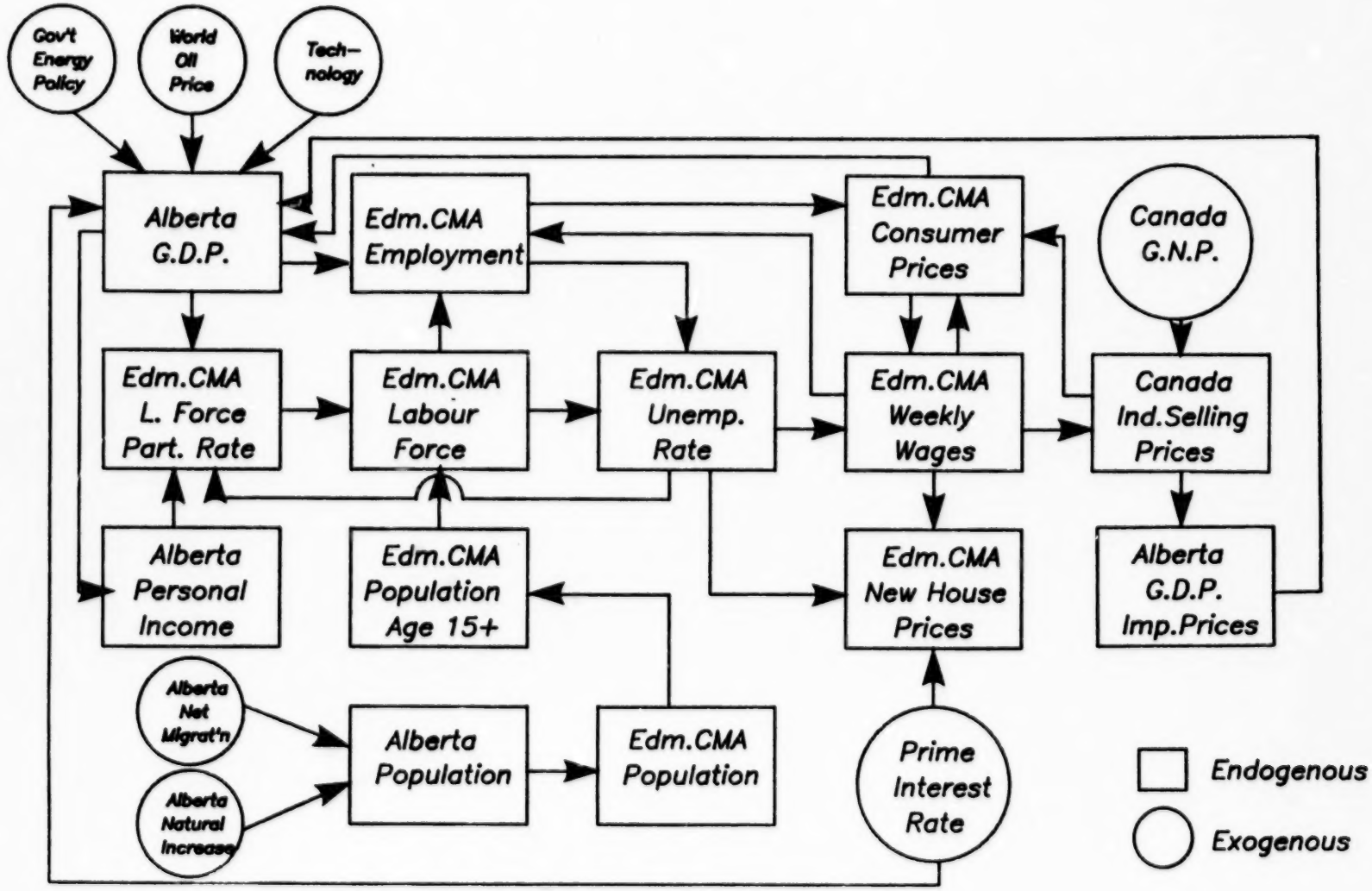
Alberta's general economic activity has a significant influence on the Edmonton economy. An evaluation of oil price impacts on the Edmonton economy is therefore logically done first by examining its impacts on the Alberta economy. Oil price impacts on the Alberta economy were discussed in Huang's paper Impact of Oil Prices on Alberta's Economic Growth and Labour Market (June 1986); the theoretical exploration and analyses in this section are therefore drawn mainly from the Huang's paper.

A. Alberta's Gross Domestic Product

The level of Alberta's total production is determined by the levels of production factors such as labour and capital stock, and by other factors such as world oil prices, technology and government energy policies. The relationships of these factors with Alberta's gross domestic product are examined in some detail below.

As a resources-based economy, Alberta's gross domestic product has been affected significantly by the world oil prices. During the period of

Figure 1
Oil Price Impacts on Edmonton's Economy
Flow Chart



escalating world oil prices, Alberta's gross domestic product grew at a rapid rate. When the world oil price declined, the Alberta economy advanced either more slowly or declined as evidenced during the post-1981 period.

Labour, capital stock and technology are three important factors of production; availability and the level of utilization of each of the factors determine the level of production. As total employment in the economy increases, gross domestic product is expected to rise, and vice versa.

Capital stock is an accumulation of present and previous investment which is inversely determined by the rate of interest. An increased rate of interest results in a rise of interest costs and thus discourages investors from investment. A rise in the rate of interest is therefore expected to reduce investment and total production. Conversely, a fall in the interest rate brings about higher investment and higher output.

Technical progress has made a great contribution to the total production in the world economy and raised living standards substantially through improved productivity. Similarly, technology advance has contributed significantly to the productivity and growth of the Alberta economy. Therefore, technology is an important element in Alberta's GDP growth.

The last factor which affected significantly the Alberta economy over the period of 1981 to 1984 is the National Energy Program. The National Energy Program hit the Alberta energy industry heavily through both the control of domestic oil and gas prices well under the world levels and through the imposition of a revenue tax, thus reducing cash-flow to the industry. This, combined with the declined world oil prices, virtually stalled the growth of the Alberta's investment and gross domestic product.

The above relationships between Alberta's gross domestic product and each of the determining factors can be functionally expressed as below.

$GDP = G(RWOP, EMPA, NEP, RIR, T);$

with $G'_{RWOP} > 0$, $G'_{EMPA} > 0$, $G'_{NEP} < 0$, $G'_{RIR} < 0$, $G'_{T} > 0$

Where:

GDP = Alberta's Gross Domestic Product
RWOP = World oil price deflated by Alberta's GDP implicit price index
EMPA = Alberta's total employment
NEP = National Energy Program
RIR = Prime lending rate deflated by Edmonton's consumer price index
T = Technology

B. Total Employment

Total employment in the current year is related closely to total employment in the previous year because a majority of the jobs are permanent and continuous. As reasoned by B.M. Fleisher (1970), because of their investment in the costs of hiring and specific training, employers are not always willing to lay off skilled workers in response to temporary declines in their need for labour. On the other hand, institutional employers are always less responsive to the changes of economic conditions in their employment practice. Therefore the higher is total employment last year, the higher will be the employment this year.

In addition, total employment is positively dependent upon the level of the general economic activity. This reflects the demand side of the labour market. When the economic activity is at a higher level, it provides more employment opportunities and total employment increases accordingly. Another factor affecting demand for labour is

wage rates. When wage rates go up, demand for labour declines, resulting in lower employment. The relationship between wage rates and total employment is therefore negative. Total labour force affects the supply of labour and total employment. A higher labour force tends to be accompanied by a higher employment and vice versa. The above relationships are mathematically shown below.

EMPA = E(EMPAL1, GDP, WR, LF);
with $E'_{EMPAL1} > 0$, $E'_{GDP} > 0$, $E'_{WR} < 0$, $E'_{LF} > 0$

Where:

EMPA = Alberta's total employment
EMPAL1 = Alberta's total employment in the previous year
GDP = Alberta's Gross Domestic Product
WR = Wage rates
LF = Total labour force.

C. Personal Income Per Capita

By the same argument as in total employment, personal income in the current year is closely related to the personal income in the previous year. When the personal income last year is high, the personal income this year tends to be high as well. The other major factor influencing the personal income is the rate of economic growth as measured by gross domestic product. A higher rate of economic growth is always accompanied by a higher personal income. Mathematically, this functional relationship can be expressed as follows:

RPY = Y(RPYL1, RGDP);
with $Y'_{RPYL1} > 0$, $Y'_{RGDP} > 0$

Where:

RPY = Real personal income per capita
RPYL1 = Real personal income per capita in the previous year
RGDP = Rate of Alberta's GDP growth

D. Population

By definition, population in the present year is equal to population in the previous year plus net migration and natural increase. Factors affecting net migration to Alberta were discussed in Huang's paper, A Migration Forecasting Model for Alberta and Edmonton, (February, 1986). Natural increase is equal to previous year's population multiplied by the rate of natural increase. This definitional equation is shown below.

POPA = (1+RNI/1000)*POPAL1+MIGN

Where:

POPA = Alberta's population
POPAL1 = Alberta's population in the previous year
RNI = The rate of population natural increase per 1000 population
MIGN = Alberta's net migration.

2.2 Edmonton Labour Market

With the current rate of unemployment in Edmonton remaining above 10%, job creation to alleviate the unemployment problem has become a major issue for the City of Edmonton. In this sub-section, the important socio-economic factors influencing each component of the Edmonton labour market are examined.

A. Total Employment

Similar to the argument for Alberta's employment, the level of employment in Edmonton is determined by demand and supply of labour in the market. The major economic factors affecting demand for

labour are the level of economic activity as measured by gross domestic product and wage rates. A higher level of economic activity increases demand for labour and thus a higher level of employment. However, increased wage rates push up labour costs and reduce profits to producers, thus decreasing demand for labour and lowering the level of employment.

The supply side of the labour market is represented by the total labour force in the market. An increase in the labour force is expected to be accompanied by a rise in the level of employment through increases in the available skilled and non-skilled labour.

In addition, Edmonton's employment in the current year, by the same argument as for Alberta's employment, is closely related to the previous year's employment. A higher level of employment last year is usually translated into a higher level of employment this year.

The above relationships between Edmonton's employment and influencing factors are mathematically expressed below.

$EMPE = M(EMPEL1, LF, GDP, WR);$
with $M'_{EMPEL1} > 0$, $M'_{LF} > 0$, $M'_{GDP} > 0$, $M'_{WR} < 0$

Where:

EMPE = Edmonton's total employment
EMPEL1 = Edmonton's total employment in the previous year
LF = Edmonton's labour force
GDP = Alberta's gross domestic product
WR = Edmonton's wage rates

B. Participation Rate

The participation rate is the principal determinant affecting total labour force. Prior to forecasting the size of the labour force, the

participation rate has to be determined. As argued in Huang's previous paper (June 1986), there are four major factors affecting the participation rate, (1) general economic activity, (2) real personal income in the previous year, (3) unemployment rate in the previous year, and (4) sex composition of working age population.

During an economic boom period, when employment opportunities are abundant, more people, especially women, are attracted into the labour force. Therefore, the participation rate tends to go up during the period. The employment opportunity is reflected in the level of general economic activity which is measured by the gross domestic product (GDP). The participation rate is therefore expected to be positively related to the level of real GDP.

There are two opposite forces affecting how the unemployment rate may influence the participation rate. During economic recession, especially a prolonged recession, employment opportunities are scarce, unemployed workers are discouraged and may withdraw from the labour market, thus reducing the participation rate. On the other hand, during this period, additional workers may have to enter the labour market to bolster declining family income, thus raising the participation rate. Therefore, the relationship of the unemployment rate with the participation rate depends on which force is stronger (See Jacob Mincer, 1971; W.G. Bowen et. al., 1969).

Another important factor affecting the participation rate is the real personal income. When one's income in the previous year is high, a person is more likely to stay in the labour force and other members of the family may enter the labour market in order to maintain or increase the high living standard. The participation rate is therefore likely to go up when the previous year's personal income is higher.

The sex composition of the working age population (age 15 and above) has also some bearing on the overall participation rate. Historically, the female participation rate was lower than the male participation

rate. Although the difference between the two rates has been narrowing over time, it is a slow process and the gap is not expected to completely close in the foreseeable future. Therefore, the higher the percentage of the total working age population accounted for by the female working age population, the lower the overall participation rate.

The functional form of the above relationships can be expressed as follows:

$PR = P(GDP, URL1, RPYL1, FWAP);$

with $P'_{GDP} > 0$, $P'_{URL1} \lesseqgtr 0$, $P'_{RPYL1} > 0$, $P'_{FWAP} < 0$

Where:

PR = Edmonton's participation rate
GDP = Alberta's gross domestic product
URL1 = Edmonton's unemployment rate in the previous year
RPYL1 = Alberta's real personal income per capita in the previous year.
FWAP = Percent of female in total working age population.

C. Edmonton Population

Edmonton's population is assumed to be a positive function of Alberta's population, that is:

$POPE = F(POPA);$

with $F'_{POPA} > 0$

Where:

POPE = Edmonton's population
POPA = Alberta's population

D. Working-Age Population

Edmonton's working-age population is assumed to be a positive function of Edmonton's population, that is

$WAP = A(POPE);$
with $A'_{POPE} > 0$

Where:

WAP = Edmonton's working-age population
POPE = Edmonton's population

E. Labour Force

Labour force is a product of participation rate and working-age population, that is

$LF = PR*WAP$

Where:

LF = Labour force
PR = Participation rate
WAP = Working-age population

F. Unemployment Rate

The unemployment rate is computed by the following formula:

$UR = 100*(LF-EMPE)/LF$

Where:

UR = Unemployment rate
LF = Labour force
EMPE = Employment

2.3 Wages and Prices

In this section, wages, consumer prices, new housing prices in Edmonton, Canadian industrial selling prices and Alberta gross domestic product implicit price are discussed.

A. Wages

Wage negotiations between unions and employers are usually influenced by the inflation rate as measured by the increase of the consumer price index, and by the unemployment rate. During a period of high inflation rates, unions tend to ask for higher wage increases to compensate for the loss of their purchasing power. Conversely, during a recession with a high rate of unemployment, unions may tend to exercise restraint in their wage demands. Therefore, the consumer price has a positive influence while the unemployment rate has a negative impact on the wage settlements. Regional wage rates tend to follow the trend of national wage rates which are also positively affected by the movement of consumer prices. Mathematically, these relationships are shown below:

$$WR = W(CPI, URL1);$$

with $W'_{CPI} > 0$, $W'_{URL1} < 0$

Where:

WR = Wage rate
CPI = Consumer Price
URL1 = Unemployment rate in the previous year

B. Consumer Prices

Price advance is caused by two forces: an increase in demand called the "demand-pulled", and a rise in costs called the "cost-pushed". Changes in the consumer prices are also caused by these two forces.

Demand for consumer goods is affected by the level of employment and the level of wage earnings. When the level of employment or the level of wage earnings increases, demand for consumer goods rises. As a result, the consumer prices are forced to go up.

Producers or suppliers tend to raise the prices of their products when their costs increase. There are two principal cost factors, one is wage costs and the other is material costs as measured by the industrial selling price. When the wage costs or the material costs go up, producers always try to pass these costs forward to the buyers by raising the prices of their products. Based on the above discussion, the wage rate affects the consumer prices through both the "demand-pulled" and the "cost-pushed".

The above functional relationships are shown below:

$CPI = C(EMPE, WRL1, ISPL1);$
with $C'_{EMPE} > 0$, $C'_{WRL1} > 0$, $C'_{ISPL1} > 0$

Where:

CPI = Consumer Price
EMPE = Edmonton's employment
WRL1 = Wage rate in the previous year
ISPL1 = Industrial selling price in the previous year

C. <u>New Housing Prices</u>

The new housing prices follow the same theory as discussed in the consumer prices. The demand for new housing is determined positively by the wage earnings and negatively by the unemployment rate. When the wage earnings increase or the unemployment rate falls, the demand for new housing tends to rise.

Demand for housing is also negatively influenced by interest rates. When interest rates go up, the demand for housing tends to decline. Therefore, based on the demand side, the interest rate has a negative relationship to the new housing price index. However, based on the supply side, an increase in the interest rate causes a rise in the financing cost and thus the new housing price index. As a result, the net impact of the interest rate on the new housing prices depends on which of the two opposite forces is stronger.

The above relationships can be expressed as follows:

$NHP = H(WR, UR, IR);$
with $H'_{WR} > 0$, $H'_{UR} < 0$, $H'_{IR} \gtrless 0$

Where:

NHP = New housing price
WR = Wage rate
UR = Unemployment rate
IR = Interest rate

D. Canadian Industrial Selling Prices

Similarly, the Canadian industrial selling price is determined by the demand and cost factors. The demand forces are expressed in the level of the Canadian gross national product and the wage earnings. The wage earnings, at the same time, exert upward pressure on the industrial selling price through the cost factor. Both factors, therefore, have a positive influence on the industrial selling price. These relationships can be shown as below:

$ISP = S(GNP, WR);$
with $S'_{GNP} > 0$, $S'_{WR} > 0$

Where:

ISP = Industrial selling price
GNP = Canadian gross national product
WR = Wage rate

E. Alberta's GDP Implicit Price

Alberta's GDP implicit price is assumed to follow the same trend as the industrial selling price. Both the current level and the previous level of the industrial selling price are expected to have a positive effect on the Alberta's GDP implicit price. Mathematically, the relationship is shown as below:

GDPIP=D(ISP, ISPL1);
with $D'_{ISP} > 0$, $D'_{ISPL1} > 0$

Where:

GDPIP = Alberta's GDP implicit price
ISP = Industrial selling price
ISPL1 = Industrial selling price in the previous year.

3. ESTIMATION OF THE MODEL

The structural relationships as discussed in the previous section were tested and estimated for the period 1971 to 1985, using the ordinary least squares techniques and the Cochrane-Orcutt method when a serial-autocorrelation is present in an equation. The estimated model is shown below, with the Student's "t" statistic shown in the parenthesis below the estimated coefficient.

3.1 Alberta's General Economic Activity

1) GDP = -149.822 + 0.0765 T - 0.6026 NEP + 0.0716 (WOP/GDPIP)*100
(1.67) (1.66) (4.93) (2.17)
- 0.0479 (IR-CPI) + 0.0109 EMPA
(1.85) (7.02)

R^2 = 0.9975, R^{-2} = 0.9961, SEE = 0.142, DW = 2.17

2) EMPA = -138 + 0.2713 EMPAL1 + 29.232 GDP + 0.746 LFA - 0.887 WR
(2.45) (2.06) (5.10) (3.21) (2.81)

R^2 = 0.9987, R^{-2} = 0.9981, SEE = 7.97, DW = 2.23

3) RPY = 548 + 0.9624 RPYL1 + 49.7817 RGDP
(1.05)(22.68) (2.70)

R^2 = 0.9836, R^{-2} = 0.9809, SEE = 225, DW = 1.31

4) POPA = (1 + RNI/1000)*POPAL1 + MIGN

3.2 Edmonton Labour Market

5) EMPE = -66 + 0.22 EMPEL1 + 8.50 GDP - 0.3923 WR + 0.9772 LFE
(6.16) (3.11) (5.40) (8.21) (10.13)

$R^2 = 0.9976$, $R^{-2} = 0.9966$, SEE = 3.311, DW = 1.57

6) PR = 45.67 + 0.90 GDP - 0.1082 URL1 + 0.0012 RPYL1
(23.39) (1.89) (1.08) (1.99)

$R^2 = 0.9454$, $R^{-2} = 0.9305$, SEE = 1.10, DW = 2.21

7) POPE = 332 + 0.0000652 SQ(POPA)
(43.01) (37.79)

$R^2 = 0.997$, $R^{-2} = 0.997$, SEE = 3.884, DW = 1.91, Rho = 0.4216

8) WAP = -3230 + 578.2395 ln (POPE)
(18.44) (20.97)

$R^2 = 0.9713$, $R^{-2} = 0.9691$, SEE = 12.58, DW = 1.33

9) LF = PR*WAP/100

10) UR = 100*(LF-EMPE)/LF

3.3 Wages and Prices

11) WR = -12.69 - 3.2065 URL1 + 3.87 CPI
(4.58) (8.23) (91.29)

$R^2 = 0.9990$, $R^{-2} = 0.9988$, SEE = 3.59, DW = 1.96

12) CPI = 5.00 + 0.02 EMPE + 0.1721 WRL1 + 0.1339 ISPL1
(1.69) (1.37) (4.50) (2.32)

$R^2 = 0.9989$, $R^{-2} = 0.9986$, SEE = 1.10, DW = 1.66

13) NHP = 16.79 + 0.5029 WR - 7.7767 UR - 1.9861 IR
(3.50) (6.91) (4.93) (1.29)

R^2 = 0.9506, R^{-2} = 0.9371, SEE = 8.44, DW = 1.64

14) ISP = -26.27 + 0.3919 GNP + 0.6772 WR
(1.21) (1.45) (17.91)

R^2 = 0.9965, R^{-2} = 0.9959, SEE = 5.03, DW = 1.38

15) GDPIP = -42.44 + 0.6225 ISP + 0.8994 ISPL1
(7.39) (2.61) (3.66)

R^2=0.9967, R^{-2}=0.9961, SEE=7.30, DW=1.32

Where:

CPI = Edmonton's consumer price index, 1981=100.
EMPA = Alberta's total employment, in thousands of persons.
EMPE = Edmonton's total employment, in thousands of persons.
GDP = Alberta's gross domestic product, in billions of 1971 dollars.
GDPIP = Alberta's GDP implicit price index, 1971=100.
GNP = Canada's gross national product, in billions of 1971 dollars.
IR = Average prime lending rate, in percent.
ISP = Canada's industrial selling price index, 1971=100.
LFA = Alberta's labour force, in thousands of persons.
LFE = Edmonton's labour force, in thousands of persons.
MIGN = Alberta's net migration, in thousands of persons.
NEP = National Energy Program, 1 for 1982 to 1984, 0 for other years.
NHP = Edmonton's new housing price index, 1976=100.
POPA = Alberta's population, in thousands of persons.
POPE = Edmonton's population, in thousands of persons.
PR = Edmonton's labour force participation rate, in percent.
RGDP = Annual rate of growth of Alberta's gross domestic product, in percent.

RNI = Rate of national increase per 1,000 Alberta's population.

RPY = Personal income per capita in Alberta, in 1971 dollars.

T = Actual calendar year, e.g., 1971 ... 1985, measuring technical progress.

UR = Edmonton's unemployment rate, in percent.

WAP = Edmonton's population with age 15 and above, in thousands of persons.

WOR = World oil price, in US dollars per barrel.

WR = Edmonton's weekly wage earnings, in dollars.

-L1 = Previous year's value for the variable.

ln = Natural logarithm

SQ = Square of the variable

R^2 = Coefficient of multiple correlation.

R^{-2} = Coefficient of multiple correlation, corrected for degree of freedom.

SEE = Standard error of regression estimate.

DW = Durbin-Watson statistic.

Rho = Coefficient of serial autocorrelation.

4. IMPACTS OF OIL PRICES

By solving all equations in the model simultaneously for all the endogenous variables, the quantitative impacts of oil price changes can be estimated. Over the period 1971-1985, a one dollar increase in the real world oil price (in 1971 U.S. dollars) is estimated to result in an increase of Alberta's gross domestic product by about $105 million and a rise of Alberta's employment by about 3,075 persons; Edmonton's employment are estimated to increase by 1,266 persons, Edmonton's participation rate to rise by 0.1, Edmonton's labour force to increase by 470 persons and Edmonton's unemployment rate to drop by 0.43%. Weekly wages in Edmonton are estimated to go up by $0.10, Edmonton's consumer price index to rise by 0.03%, Canadian industrial selling price index to increase by 0.03% and Alberta's GDP implicit price index to climb by 0.02%.

As in Huang's previous paper (June 1986), two different world oil price scenarios are examined in this section and their impacts on the Alberta and the Edmonton economy are shown on Tables 1 and 2. The first scenario uses the world oil price forecasts prepared by the City of Edmonton Forecast Committee (June 1986). In this case, the world oil price is projected to average $16 (US)/barrel in 1986 and then increase gradually to $27 (US)/barrel in 1991. The second scenario, called "base case", assumes the world oil price will average $15 (US)/barrel in 1986 and will rise at the same rate as inflation to $18.41 (US)/barrel in 1991. This oil price scenario is based on a presentation by C. Begie of Dominion Securities Pitfield Limited to senior City of Edmonton officials on May 22, 1986.

In order to evaluate the impacts of the different oil price forecasts, both scenarios use a same set of assumptions on the exogenous variables in the model, e.g., interest rate, Canada's GNP growth and government energy policy. The prime lending rate is assumed to average 10.5% in 1986 and 10% in 1987 and decline by 0.25% per year to 9% in 1991. Canada's gross national product is assumed to grow at 3.5% in 1986 and 3% per year for the period 1987 to 1991. The National Energy Programme is assumed to be non-existent over the period 1986 to 1991.

As shown in Table 1, under the City Forecast Committee scenario, the Alberta gross domestic product will drop by approximately 1.3% in 1986. The economy will return to a positive growth for the period 1987 to 1991, with a growth rate ranging from 2.1% in 1987 to 3.0% in 1990. Edmonton's population will increase from 705,000 in 1986 to 765,000 in 1991. Edmonton's labour force will continue to rise from 408,000 in 1986 to 445,000 in 1991; employment will increase from 358,000 in 1986 to 384,000 in 1991 while the unemployment rate will remain in the range of 12.1% to 13.7% over the forecast period of 1986 to 1991. Weekly wages in Edmonton will go up at a rate ranging from 3.3% in 1986 to 3.6% in 1991, while the consumer price index will increase at a slightly smaller rate ranging from 3.0% in 1986 to 3.4% in 1991. Edmonton's new housing price index is forecast to rise at a rate of 4.3% to 10% per year and Canada's industrial selling price index is expected to increase from 3.6% in 1986 to 3.8% in 1991.

The economic activity in Alberta and Edmonton will be slightly slower under the base scenario as compared with the City Forecast Committee scenario. As shown in Table 2, the Alberta economy will similarly be in a recession in 1986, with 1.6% drop in GDP. Over the period 1987 to 1991, Alberta's GDP is forecast to increase by 1.1% to 2.5% per year. Edmonton's population is expected to rise from 705,000 in 1986 to 753,000 in 1991; Edmonton's labour force will go up from 407,000 in 1986 to 436,000 in 1991; employment will increase from 357,000 in 1986 to 373,000 in 1991, while the unemployment rate will rise from 12.2% in 1986 to 14.5% in 1991. Weekly wages in Edmonton will rise by 2.9% to 3.5% per year while the consumer price index will be up by 2.8% to 3.3% per year over the forecast period. Edmonton's new housing price index is expected to rise by 1.9% to 9.3% per year and Canada's industrial selling price index will increase by 3.1% to 3.7% per year over the same period.

Comparing the impacts of different oil prices as discussed above, it is obvious that a higher oil price will bring about a higher level of economic activity, a higher level of employment, a lower unemployment rate and a higher level of

wages and prices in Edmonton. For instance, under the City of Edmonton Forecast Committee scenario, as compared to the base scenario, Alberta's gross domestic product will be $620 million higher and the real income per person will be 1.3% higher by 1991. Edmonton will have 12,000 more people, 9,000 more persons in the labour force, 11,000 more persons employed and 0.8% lower in the unemployment rate by 1991. Similarly, workers in Edmonton will be paid $12.19 (or 2.38%) more per week while the consumer price will be 1.6% higher, the new housing price will be 8.6% higher and the Canada's industrial selling price will be 2.1% higher by 1991 (see Charts 1 to 12).

5. CONCLUSIONS

The model presented in this paper describes the dynamic nature of the interrelationships among various economic forces (factors) in the Alberta and Edmonton economy. The model was tested and its parameters were estimated using data for the period 1971 to 1985. By simulating the model, the impacts of different world oil prices on the Alberta and Edmonton economy can be estimated. Two different oil price scenarios were assumed and applied to the model in this paper and their impacts on the Alberta and Edmonton economy were compared. As expected, under the higher oil price scenario, the Alberta and Edmonton economy is brighter, with a higher level of output, more population, a higher level of employment and a lower rate of unemployment and higher levels of weekly wages and prices.

In addition to assessing the impacts of world oil price changes on the Alberta and Edmonton economy, the model can also be used to evaluate the impacts on the Edmonton economy of different government policies such as the Bank of Canada's interest rate policy and the Federal and Alberta Government's taxation policy on the oil industry.

The model developed in this paper will become a sub-model of the large scale econometric model of the Edmonton economy being developed by the Corporate Forecasting Group of the Edmonton Planning and Building Department.

Table 1 10-Oct-86

OIL PRICE IMPACTS ON THE EDMONTON ECONOMY

(City Forecast Committee)

YEAR	OIL PRICE*	PRIME RATE*	CANADA GNP GROWTH*	CANADA GNP	INDUSTRIAL SELL. PRICE	% INCR ISP	ALBERTA GDP	ALBERTA GDP GROWTH	ALBERTA PER.INCOME	ALBERTA POP	ALBERTA EMPLY.	GDP DEFLATOR
	(us$/b)	(%)	(%)	($ billion)	(1971=100)	(%)	($ billion)	(%)	($/Person)	('000)	('000)	(1971=100)
1985	28.00	10.70	4.5	146.48	319.2	2.7	14.42	5.10	13,050	2,349	1,123	436.4
1986	16.00	10.50	3.5	151.61	330.6	3.6	14.24	-1.30	13,011	2,373	1,132	450.5
1987	19.00	10.00	3.0	156.15	343.2	3.8	14.53	2.07	13,142	2,405	1,146	468.5
1988	22.00	9.75	3.0	160.84	356.2	3.8	14.91	2.60	13,294	2,439	1,168	487.9
1989	24.00	9.50	3.0	165.66	369.4	3.7	15.31	2.66	13,442	2,475	1,195	507.9
1990	26.00	9.25	3.0	170.63	383.2	3.7	15.71	2.64	13,584	2,514	1,223	528.4
1991	27.00	9.00	3.0	175.75	397.5	3.7	16.18	2.97	13,736	2,560	1,258	549.6

YEAR	EDM CMA POPULATION	POPULATION 15+	PART RATE	LABOUR FORCE	EMPLOYMENT	UNEMPLOYMENT RATE	WEEKLY WAGES	WAGE INCREASE	CONSUMER PRICES	% INCR CPI	NEW HOUSING PRICE	% INCR NHP
	('000)	('000)	(%)	('000)	('000)	(%)	($)	(%)	(1981=100)	(%)	(1976=100)	(%)
1985	692	552	72.0	397	349	12.2	425.08	2.6	124.3	3.2	111.5	-6.1
1986	705	562	72.5	408	358	12.1	439.27	3.3	128.1	3.0	122.5	9.9
1987	715	570	72.4	413	362	12.4	455.17	3.6	132.1	3.2	129.3	5.5
1988	726	579	72.6	420	366	12.8	471.68	3.6	136.6	3.4	134.9	4.3
1989	737	588	72.7	428	371	13.2	488.47	3.6	141.3	3.4	141.1	4.6
1990	750	598	72.8	436	377	13.5	505.86	3.6	146.1	3.4	147.9	4.8
1991	765	610	73.0	445	384	13.7	524.07	3.6	151.0	3.4	156.0	5.5

* exogenous variables

Table 2

OIL PRICE IMPACTS ON THE EDMONTON ECONOMY

(Base Case)

10-Oct-86

YEAR	OIL PRICE*	PRIME RATE*	CANADA GNP GROWTH*	CANADA GNP	INDUSTRIAL SELL. PRICE	% INCR ISP	ALBERTA GDP	ALBERTA GDP GROWTH	ALBERTA PER.INCOME	ALBERTA POP	ALBERTA EMPLY.	GDP DEFLATOR
	(us$/b)	(%)	(%)	($ billion)	(1971=100)	(%)	($ billion)	(%)	($/Person)	('000)	('000)	(1971=100)
1985	28.00	10.70	4.5	146.48	319.2	2.7	14.42	5.10	13,050	2,349	1,123	436.4
1986	15.00	10.50	3.5	151.61	330.6	3.6	14.20	-1.56	12,998	2,372	1,130	450.5
1987	15.53	10.00	3.0	156.15	342.8	3.7	14.36	1.14	13,083	2,398	1,135	468.3
1988	16.10	9.75	3.0	160.84	354.7	3.5	14.59	1.59	13,187	2,425	1,147	486.7
1989	16.78	9.50	3.0	165.66	366.1	3.2	14.87	1.93	13,303	2,456	1,166	504.5
1990	17.54	9.25	3.0	170.63	377.4	3.1	15.18	2.06	13,422	2,488	1,187	521.8
1991	18.41	9.00	3.0	175.75	389.3	3.1	15.56	2.53	13,559	2,523	1,214	539.4

YEAR	EDM CMA POPULATION	POPULATION 15+	PART RATE	LABOUR FORCE	EMPLOYMENT	UNEMPLOYMENT RATE	WEEKLY WAGES	WAGE INCREASE	CONSUMER PRICES	% INCR CPI	NEW HOUSING PRICE	% INCR NHP
	('000)	('000)	(%)	('000)	('000)	(%)	($)	(%)	(1981=100)	(%)	(1976=100)	(%)
1985	692	552	72.0	397	349	12.2	425.08	2.6	124.3	3.2	111.5	-6.1
1986	705	562	72.4	407	357	12.2	439.23	3.3	128.0	3.0	121.9	9.3
1987	713	569	72.4	412	359	12.8	454.62	3.5	132.0	3.1	126.1	3.5
1988	722	576	72.4	417	361	13.5	469.49	3.3	136.4	3.3	128.5	1.9
1989	731	583	72.5	423	363	14.0	483.46	3.0	140.6	3.1	132.2	2.9
1990	742	591	72.5	429	368	14.3	497.39	2.9	144.6	2.9	137.0	3.7
1991	753	600	72.7	436	373	14.5	511.88	2.9	148.6	2.8	143.6	4.8

* exogenous variables

CHART 1
ALBERTA ECONOMIC GROWTH RATE

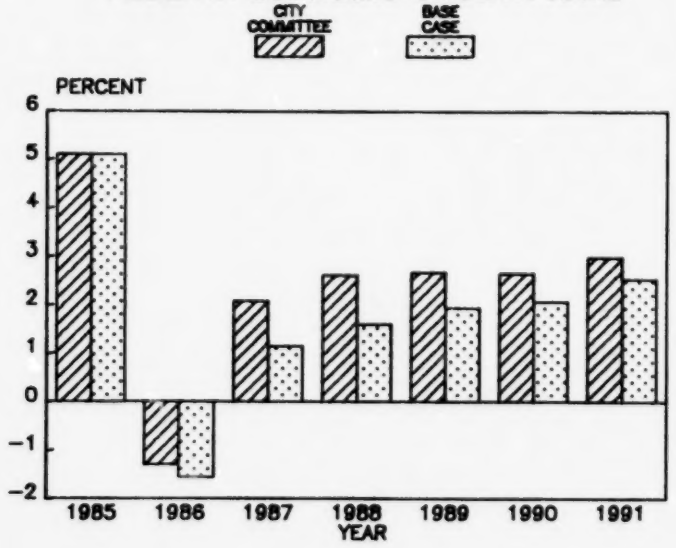


CHART 2
ALBERTA REAL GROSS DOMESTIC PRODUCT

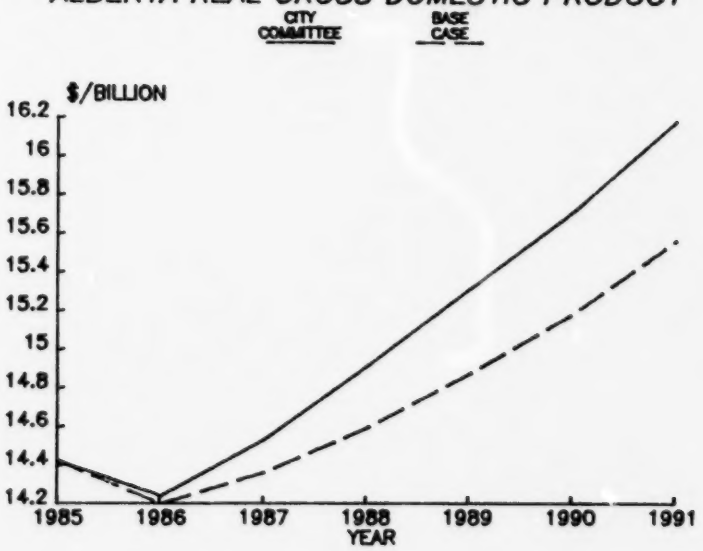


CHART 3
ALBERTA REAL PERSONAL INCOME PER CAPITA

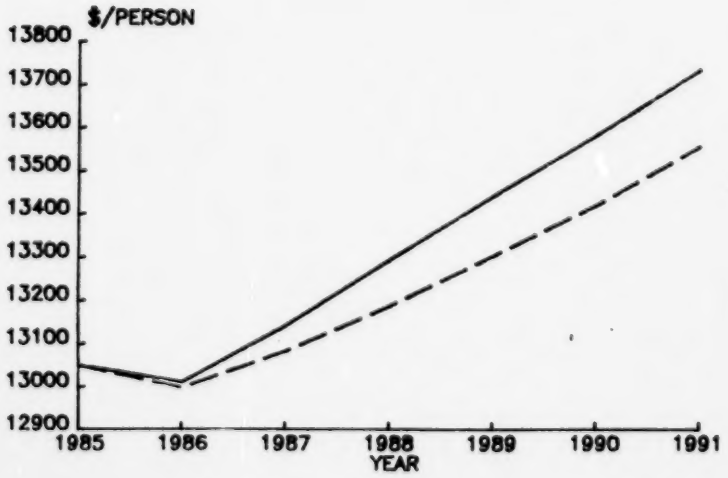


CHART 4
EDMONTON CMA POPULATION

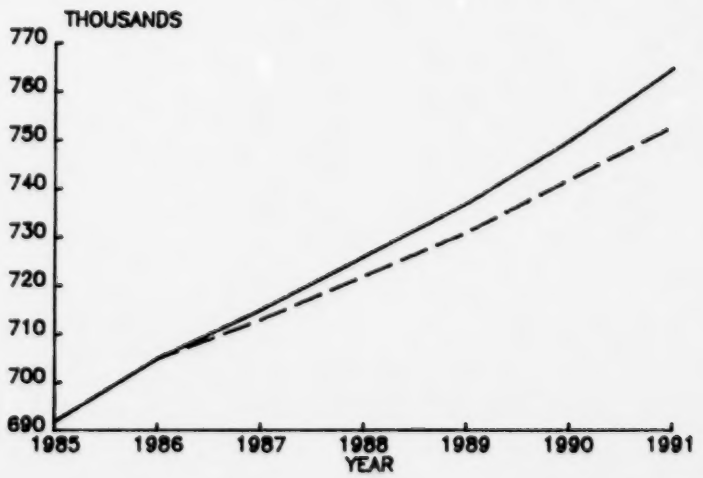


CHART 5 – EDMONTON CMA
LABOUR FORCE– PARTICIPATION RATE

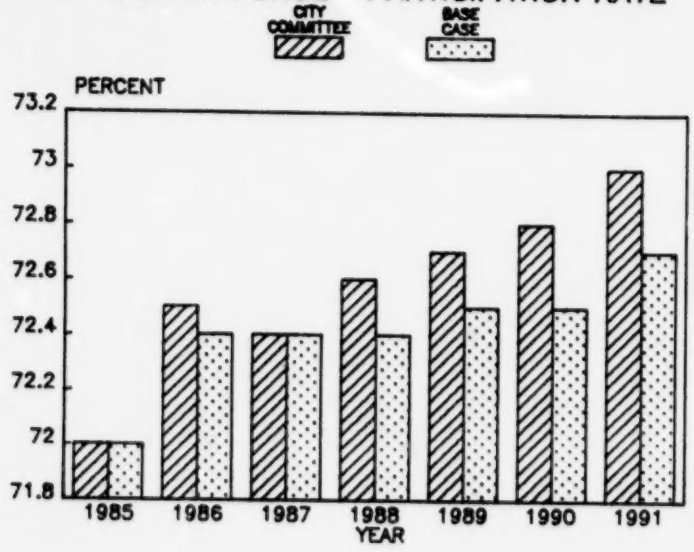


CHART 6
EDMONTON CMA – LABOUR FORCE

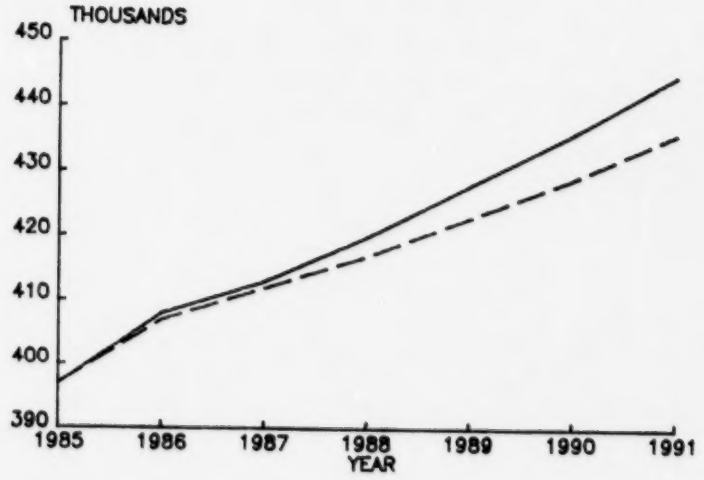


CHART 7
EDMONTON CMA – TOTAL EMPLOYMENT

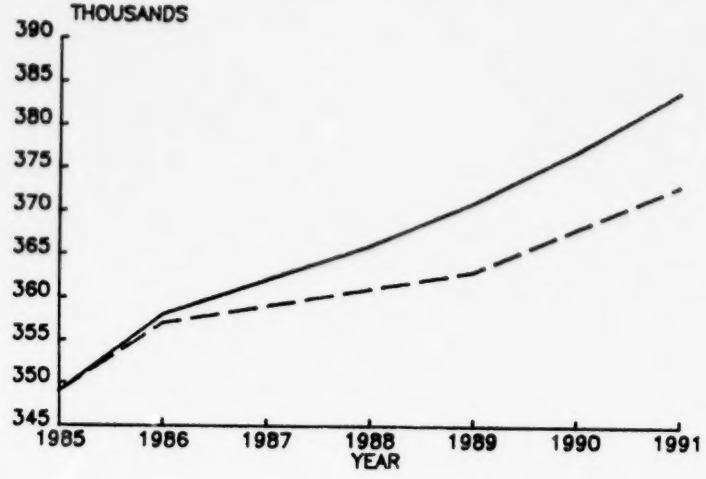


CHART 8
EDMONTON CMA – UNEMPLOYMENT RATE

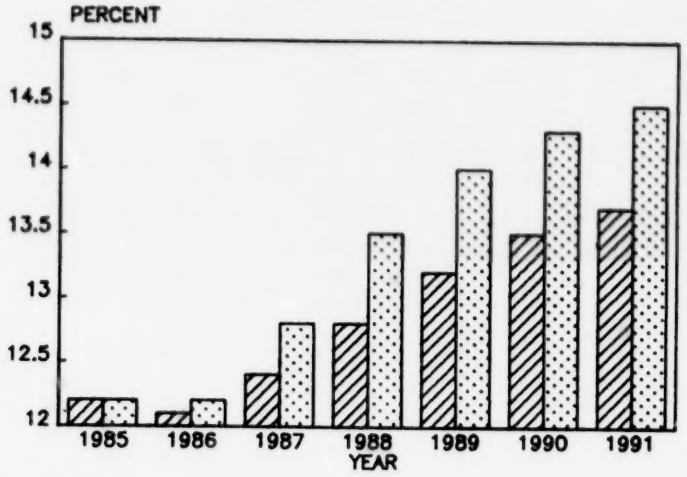


CHART 9
EDMONTON CMA – WEEKLY WAGE INCREASE

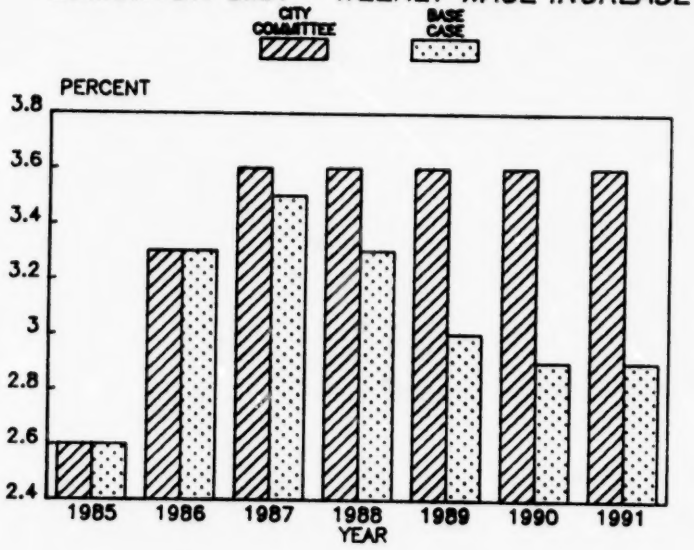


CHART 10
EDMONTON CMA – CONSUMER PRICE INCREASE

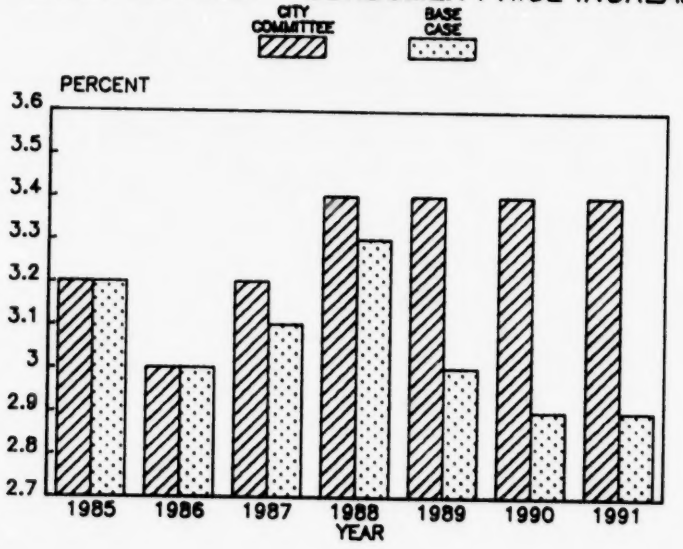


CHART 11 EDMONTON CMA
PERCENT INCREASE – NEW HOUSING PRICE

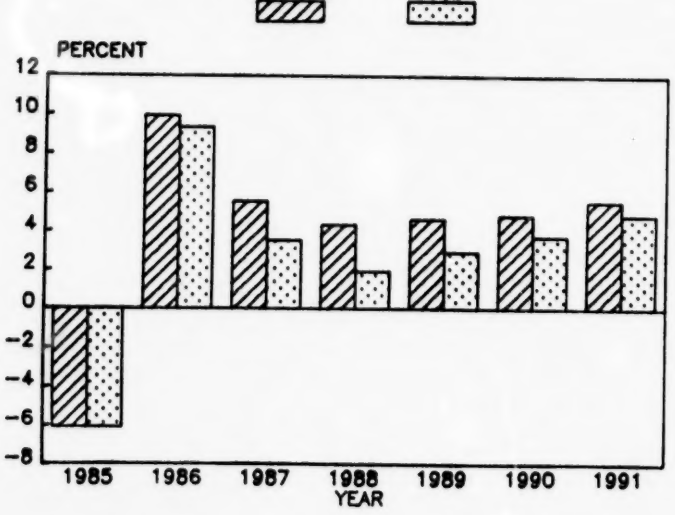
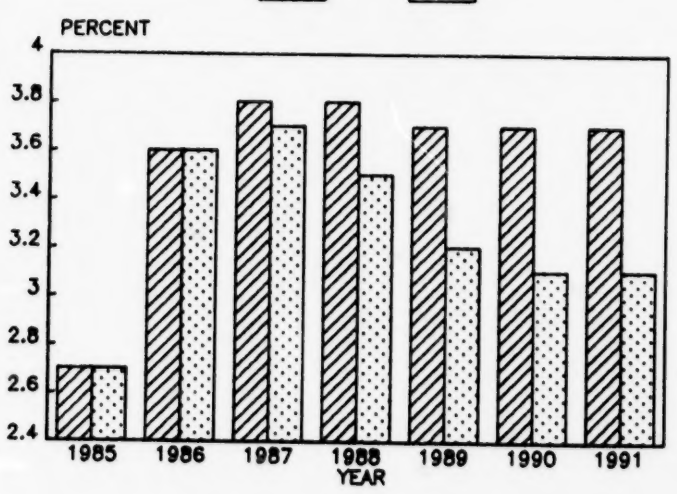


CHART 12
CANADA – INDUSTRIAL SELLING PRICE INCREASE



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APPENDIX

HISTORICAL DATA, 1971-1985

HISTORICAL DATA 1971-1985

Year	World Oil Price (US$/barrel)	Prime Rate (%)	Canada GNP (1971 $billion)	Canada Industrial Selling Price (1971=100)	Alberta GDP (1971 $billion)	Alberta Personal Income (1971 $/billion)
19[illegible]	2.29	6.48	94.450	100.00	7.866	8.124
1972	2.48	6.00	100.248	104.50	8.457	8.648
1973	5.04	7.65	107.812	116.10	9.296	9.288
1974	11.25	10.75	111.678	138.10	9.688	10.063
1975	11.25	9.42	113.005	153.70	10.139	10.737
1976	11.50	10.04	119.249	161.60	10.594	11.054
1977	12.70	8.50	121.762	174.30	11.186	11.103
1978	15.00	9.69	126.191	190.40	11.975	11.316
1979	28.75	12.90	129.850	217.90	13.227	11.979
1980	38.00	14.25	130.467	247.20	13.906	12.424
1981	34.00	19.29	136.114	272.40	14.553	13.040
1982	34.00	15.81	130.069	288.80	13.870	12.865
1983	29.00	11.20	134.361	298.80	13.442	12.521
1984	29.00	12.10	141.097	310.90	13.629	12.710
1985	28.00	10.70	146.479	319.25	14.174	13.050

Sources:
1. Petroleum Marketing Commission - Calgary
2. Bank of Canada Review
3. Statistics Canada
4. Alberta Bureau of Statistics

HISTORICAL DATA 1971-1985

Year	National Energy Program	Alberta Population (000)	Alberta Employment (000)	Alberta GDP Deflator (1971=100)	Edmonton CMA Population (000)	Edmonton CMA Population 15+ (000)
1971	0	1,628	643	100.0	496	341
1972	0	1,657	688	105.3	506	331
1973	0	1,690	718	119.6	515	355
1974	0	1,722	754	161.4	526	394
1975	0	1,778	788	184.0	537	409
1976	0	1,838	837	203.7	556	419
1977	0	1,913	868	218.4	568	417
1978	0	1,983	915	236.5	580	438
1979	0	2,053	1,007	265.0	599	453
1980	0	2,141	1,078	302.2	619	481
1981	0	2,237	1,152	337.0	657	502
1982	1	2,319	1,132	381.0	681	518
1983	1	2,347	1,115	407.8	691	528
1984	1	2,341	1,114	421.6	688	523
1985	0	2,349	1,123	436.4	692	552

Sources:
1. Alberta Bureau of Statistics
2. Statistics Canada

HISTORICAL DATA 1971-1985

Year	Edmonton CMA Participation Rate (%)	Edmonton CMA Labour Force (000)	Edmonton CMA Employment (000)	Edmonton CMA Unemployment Rate (%)	Edmonton CMA Weekly Wages ($)	Edmonton CMA Consumer Price (1981=100)
1971	62.2	210	199	5.2	130.42	41.9
1972	62.1	204	193	5.1	142.44	43.8
1973	63.1	218	208	4.7	153.08	47.6
1974	63.5	241	233	3.1	171.30	52.1
1975	68.2	279	268	4.0	197.74	57.7
1976	69.2	290	278	4.0	219.03	62.3
1977	67.7	282	270	4.3	241.09	68.0
1978	69.5	305	290	4.7	257.65	74.1
1979	71.2	322	310	3.7	291.12	80.7
1980	72.0	347	332	4.1	320.54	88.9
1981	73.9	371	356	4.1	363.31	100.0
1982	72.8	377	347	8.0	399.80	110.8
1983	71.4	377	332	12.1	409.81	117.2
1984	72.9	381	328	14.1	414.71	120.4
1985	72.0	397	349	12.2	425.08	124.3

Sources:
1. Alberta Bureau of Statistics
2. Statistics Canada

HISTORICAL DATA 1971-1985

Year	Edmonton CMA New Housing Price (1976=100)
1971	41.3
1972	44.4
1973	53.9
1974	70.2
1975	83.5
1976	100.0
1977	106.9
1978	114.3
1979	123.0
1980	132.7
1981	139.9
1982	137.2
1983	126.5
1984	118.8
1985	111.5

Source: Statistics Canada